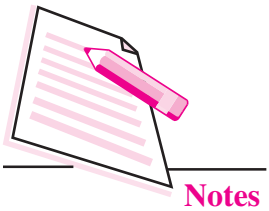


Notes

# 15

# CIRCULATION OF BODY FLUIDS

The body of almost all the animals, has some form of fluid circulating in the body. Such fluids constitute the distributing system (to supply substances) as well as collecting system (to pick up substances) from the various parts of the body (including the remotest cell). What are these fluids? How are these circulated and in what way do they function in our body? These and many more questions will be answered in this lesson.

## OBJECTIVES

After studying this lesson, you will be able to :

- *explain the importance of the circulatory system in human body;*
- *differentiate between open and closed systems of circulation;*
- *list and draw the organs of circulatory system of cockroach;*
- *list and draw the organs of circulatory system in humans*
- *describe the histology, functions and composition of blood in humans*
- *compare the structure and functions of an artery, a vein and a capillary;*
- *explain the process of blood coagulation in humans*
- *name the blood groups and describe modalities of blood transfusion;*
- *explain blood pressure;*
- *describe lymphatic system and mention its components;*
- *define immunity and describe its different types;*
- *explain various immuno-deficiency disorders;*
- *name and describe some blood related disorders such as hypertension; atheroma and arteriosclerosis;*
- *explain the importance of ECG and role of pacemaker in treating heart beat related disorders.*

## 15.1 CIRCULATORY SYSTEM

Our body is made of cells. Cells need nutrients and oxygen to survive, and wastes need to be removed from them. Hormones are also needed to be transported from the endocrine glands which secrete them to their respective target cells. This work of transportation of nutrients, gases, wastes and other substances from one part of our body to the other part, is carried out by blood, and termed **circulation**.

> The organs responsible for the flow of blood and lymph through various parts of the body constitute the circulatory system

### 1. Functions of circulatory system

(i) Transport of nutrients to the tissues for their utilization

(ii) Transport of respiratory gases ($O_2$ and $CO_2$) to and from the cells.

(iii) Collection of metabolic wastes from different tissues and transporting them to excretory organs for their removal.

(iv) Transport of hormones from endocrine glands to target organs.

(v) Protection of body by destroying pathogens.

(vi) Uniform distribution of heat in the body.

### 2. Types of Circulatory System

Depending upon the mode of circulation, the circulatory system may be open or closed type.

#### (i) Open circulatory system

(a) Blood does not flow in closed vessels rather it flows through parts of the body cavity. It remains mixed with the body fluid.

(b) Sufficient high pressure for circulation is not maintained.

Organisms like prawns, and insects have open circulatory system.

#### (ii) Closed circulatory system

(a) Blood flows in well-defined tube-like vessels.

(b) Sufficient high pressure is maintained .

(c) System is more efficient than open type.

Closed system is found in all vertebrates.

## 15.2 CIRCULATORY SYSTEM OF COCKROACH

The circulatory system of cockroach is of open type. It consists of a pulsatile heart (dorsal blood vessel) and sinuses through which the blood flows. The blood is colourless and fills the entire body cavity which is rightly called **haemocoel**. Thus the blood is called haemolymph. Haemocoel is divided into three sinuses (chambers) by two horizontal septa called **dorsal diaphragm** and **ventral diaphragm**. The three sinuses are dorsal sinus or **pericardial sinus** enclosing the heart, middle **perivisceral sinus** lodging the various visceral organs and the ventral **perineual**

**sinus** enclosing the ventral nerve cord. Both the diaphragms are perforated such that the three sinues remain in communication with each other.

The heart is an elongated, tubular structure, closed behind and open in front, running all along the middle line through thorax and abdomen. It consists of thirteen segmentedly arranged funnel shaped chambers. At the lateral side of each chamber is a pair of ostia one on each side, which are guarded by **valves**. Through these ostia, the heart communicates with the pericardial sinus. Anteriorly, the heart continues into the head as anterior aorta which opens into the haemocoel of head. Attached to each segment, is a pair of triangular **alary muscles** present on either side of the heart.

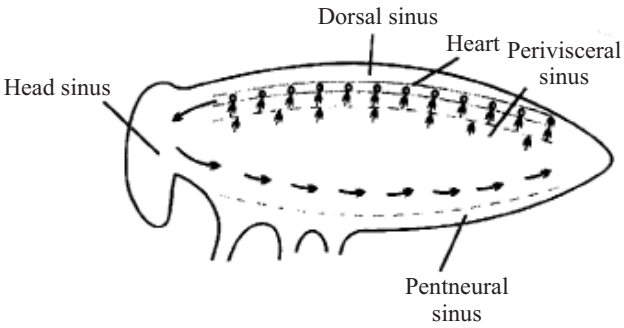



**Fig. 15.1** Circulatory system of cockroach

The blood is a colourless fluid, made up of plasma and cells termed haemocytes. Since the blood of cockroach lacks any respiratory pigment, it is not involved with the transportation of respiratory gases. It serves only for (i) the transportation of the nutrients (ii) maintenance of hydrostatic pressure and (iii) acts as a reservoir of water. The blood of cockroach circulates due to contraction and relaxation of the heart and the alary muscles.

## 15.3 ORGANS OF HUMAN CIRCULATORY SYSTEM

The circulatory system consists of the following parts :

1. Heart – the central pumping organ.
2. Blood vessels – the connecting tubes – arteries, veins and capillaries.

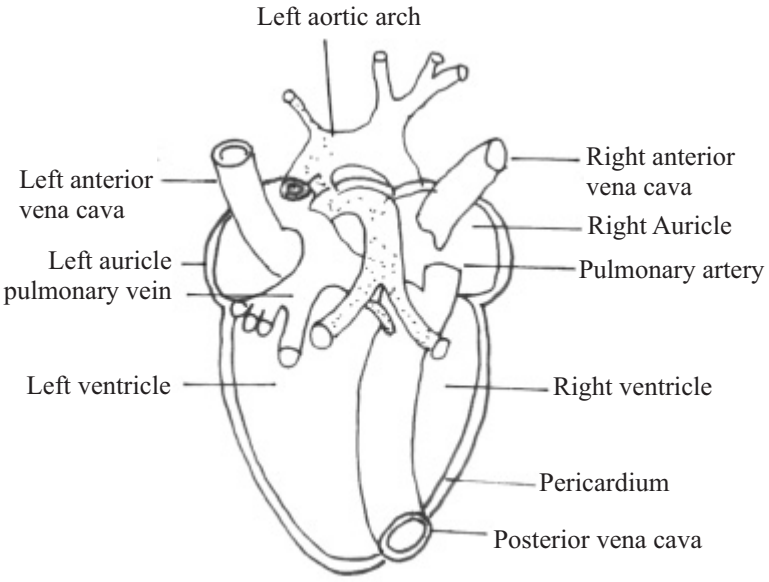
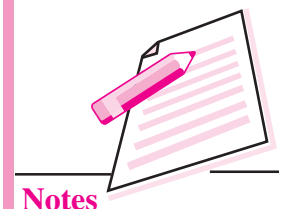



**Fig. 15.2** (a) External structure of humnan heart (Front view)





3. Blood – is the circulating fluid, a connective tissue made of a fluid matrix and cells.
4. Lymphatic system comprises of lymph nodes and lymph vessels.

## 1. The human heart

It is a muscular organ made of cardiac muscle fibres (Fig. 15.2). It is able to perform its function by coordinating contraction and, relaxation and opening and closing of a number of valves present inside the heart. This fist sized organ consists of 4 chambers, the two upper chambers – the **atria** and two lower chambers – the **ventricles**. Ventricles have thick muscular walls for pumping blood to longer distances. Heart is covered by a membrane – the **pericardium**.

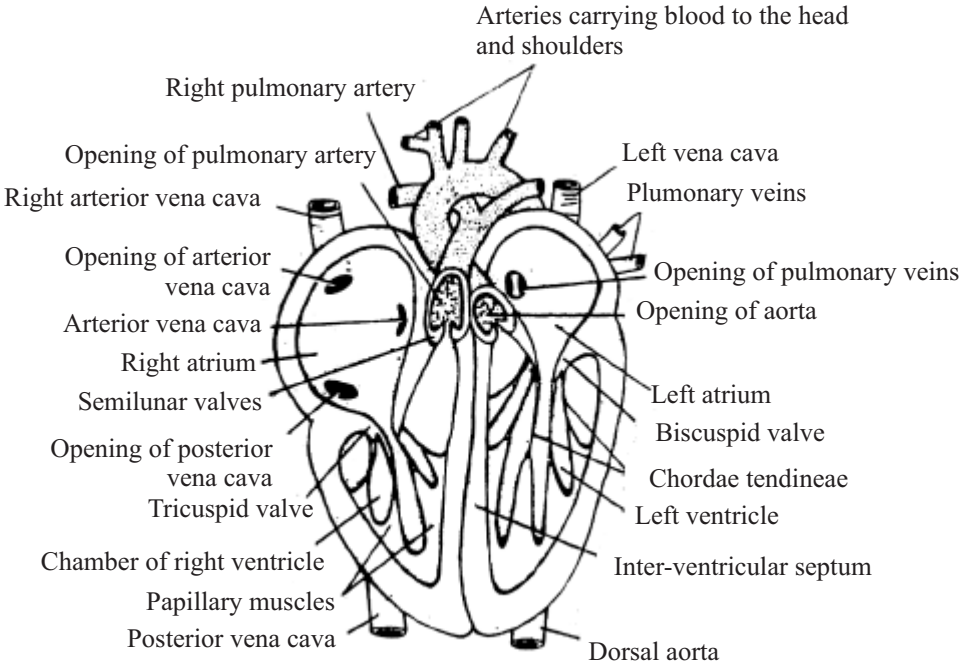



**Fig. 15.2** (b) Internal structure of human heart.

### (i) Valves inside the heart

Locate the following valves in figure 15.3. The atrio-ventricular valves are between Atria and Ventricles.

(a) Right **atrio-ventricular valve** or **tricuspid valve**

(b) Left **atrio-ventricular valve** or **bicuspid valve**

**Semilunar valves** at the origin of aorta and pulmonary artery.

Valves open only on one side like a door. They regulate the flow of blood by opening on one side to let blood flow out in one direction only and prevent the back flow of blood.

### (ii) Heart beat and cardiac cycle

The **beating of heart** goes on by itself as long as one is alive. Each heartbeat consists of the steps mentioned below and makes two sounds – **Lubb** and **Dubb** during each beat.

(a) The heart beat starts with contraction or **systole** of atria, followed by relaxation or **diastole**. The lubb sound or 1st heart sound occurs due to closure of atrioventricular valves, the atrial systole.

(b) Contraction of ventricles followed by relaxation accompanied by the dubb sound or the 2nd heart sound occurs due to closure of semi lunar valves. At the beginning of every heart beat the four chambers of the heart are in the relaxed state (**Joint diastole**). At this stage the venae cavae pour deoxygenated blood into right atrium and the pulmonary vein pours oxygenated blood into left atrium.

Heart beat originates at the **Sinu-Atrial Node or S.A Node** which is a modified part of the muscular wall in the upper corner of the right atrium (Fig. 15.3).

As a result right atrium contracts, tricuspid valve is pushed open and deoxygenated blood enters the right ventricle. At the same time, the bicuspid valve is pushed open and oxygenated blood flows into left ventricle.

**Atrio-Ventricular Node (A.V. Node),** modified muscle is located in the interatrial septum. When impulse comes from SA node to AV node, the contracted atria begin to relax and impulse passes to **Bundle of HIS** lying in the interventricular septum and then passes to **Purkinje Fibers** lying in the walls of ventricles. As a result ventricles contract (Ventricular systole)

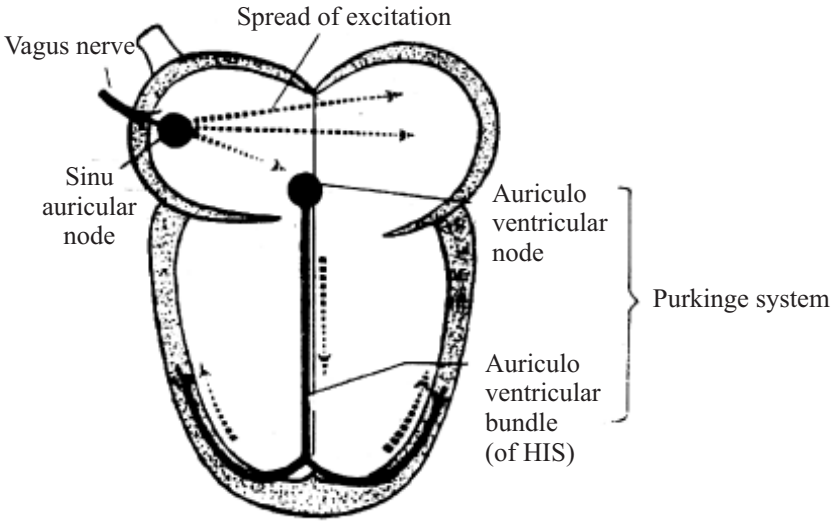



**Fig. 15.3** Position of the Sino-atrial and atrio-ventricular nodes and the bundle of HIS and conduction of impulse for heart beat.

Since Sinu-atrial Node initiates and regularizes the heartbeat, it is also called the **pacemaker**. The pacemaker is influenced by nerves, hormones, $CO_2$ and $O_2$ content of blood, and heat.

**Do You Know?**

Sometimes the S.A. (Sino-Atrial ) Node may become defective or damaged. A person may need to have an artificial pacemaker grafted in the chest. This regularizes the heartbeat.

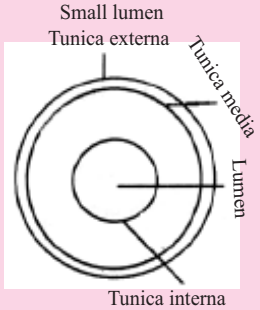
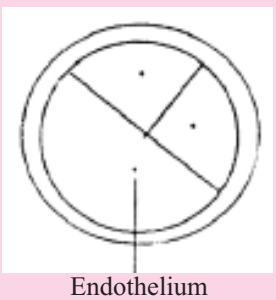
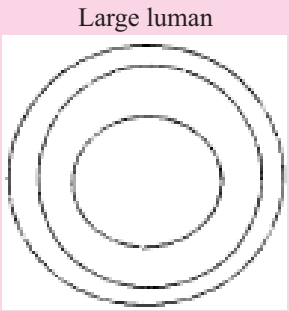
**Electro Cardiogram** (ECG) is the instrument that records the conduction of heartbeat . This helps in detecting heart beat disorders.

### 15.3.2. Blood vessels

The tubes transporting blood are called **Blood Vessels**. The wall of a blood vessel has three layers, tunica externa, tunica media and tunica interna. There are 3 kinds of blood vessels:

(i) Artery (ii) Capillary and, (iii) Vein. These three vessels differ in structure and speed of blood flow, as shown below.

**Table 15.1 Comparison in structure and function of an artery, the capillary and the vein.**

| Artery | Capillary | Vein |
|---|---|---|
| • Transports blood away from the heart. | • Capillaries link arteries to . veins for exchange of material between blood and tissues which also have capillaries | • Site of Transport of blood towards the heart. |
| • Tunica media is thick and composed of elastic, muscular tissue. | • No tunica media. Only single layer of cells forming **endothelium**. No elastic fibers | • Tunica media is relatively thin and only slightly muscular. Few elastic fibers. |
| • No semi-lunar valves. along arteries | • A semi-lunar valve present. | • Semi-lunar valves are present all along the length of vein at intervals to prevent back flow of blood |
| • Pressure of blood is high and arteries are pulsatile. | • Pressure of blood falling and non-pulsatile. | • Pressure of blood low and non-pulsatile. |
| • Blood flow rapid | • Blood flow slow | • Blood flow slow |
| • Low blood volume Blood is oxygenated except in pulmonary artery | • High blood volume Mixed oxygenated and deoxygenated blood. | • Increased blood volume<br>• Blood deoxygenated except in pulmonary vein |
| • Small lumen | • Extremely narrow lumen | • Large lumen |
|  |  |  |

Arteries divide into **Arterioles** and then into **Capillaries**. This way they come in contact with all the tissues and bathe the cells with blood plasma. Diagram 15.4 shows the possible route that blood may take between arteriole, capillary bed and venule. Capillaries join to form venule. Venules are thin blood vessels that join to form veins.

### (i) Major Arteries and Veins

Blood that has been circulated through the body has lost much of the $O_2$, it carried. This de-oxygenated blood returns to the heart by two major veins.

1. **Superior vena cava**-brings deoxygenaled blood from head and shoulder region.
2. **Inferior vena cava**-brings deoxygenated blood from lower parts of the body.

These venae cavae open in the right atrium (refer to diagram 15.2). Contraction of right atrium forces this blood into the right ventricle.

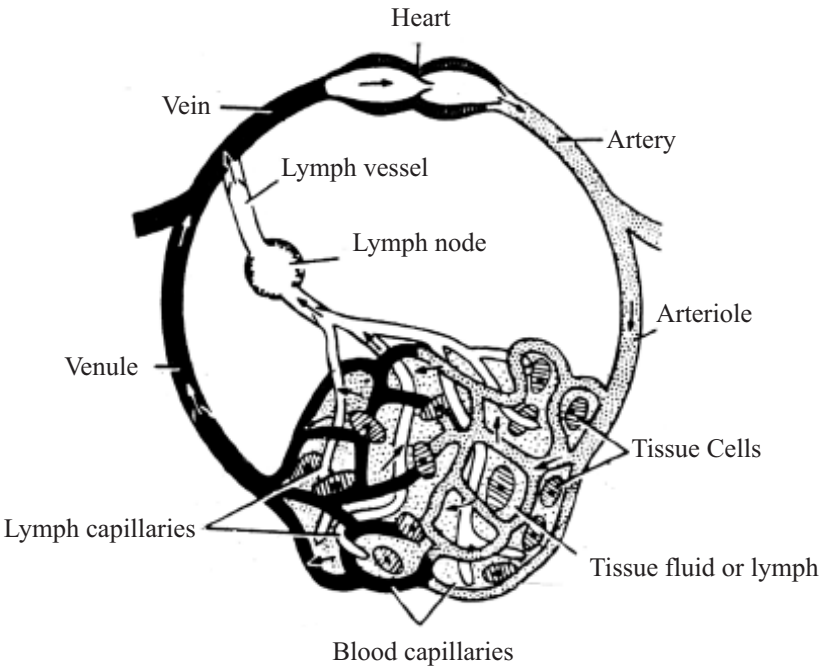



**Fig. 15.4** The route that blood takes between arteriole, capillary bed, and venule.

Contraction of right ventricle pumps blood into **pulmonary artery** which transports blood to the lungs. Blood gets oxygenated in the lungs and returns to the left atrium through the **pulmonary vein**.

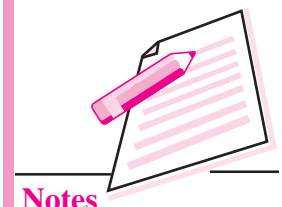
Blood then passes from the atrium into the left ventricle. Left ventricle pumps blood into aorta. The aorta distributes blood throughout the body.

See the flow diagram given below which summarizes the **path of blood** through the entire circulatory system.

### Double circulation

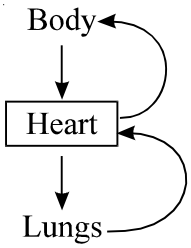
Since blood passes twice through the heart, it is termed **Double circulation**

(i) First Deoxygenated blood passes from the body to heart and oxygenated blood from heart to the body.





(ii) Then Deoxygenated blood flows from heart to lungs and oxygenated blood from lungs again to heart, from lungs.




In one circulation, the blood passes through the heart twice. Once from body to heart to lungs and second time from lungs to heart to body.

Path of circulation

First from body to heart

(Venae cavae carry blood from tissues with very little oxygen and lot of $CO_2$ to Right atrium)

↓

Tricuspid valve opens

↓

Right ventricle

↓

Pulmonary arteries

↓

(Pulmonary arteries carry blood to lungs to give up $CO_2$ and to collect $O_2$ from lungs)

Pulmonary veins

↓

(Pulmanary veins carry oxygenated blood back to left atrium of heart)

↓

Left atrium

↓

Bicuspid valve

↓

Left ventricle

↓

Aorta

(carries blood with a lot of oxygen and distributes this oxygenated blood to different parts of the body)

**Pulmonary artery** is the only artery that carries the de-oxygenated (**blood poor in $O_2$**) blood. It is called artery as it carries blood away from heart.

**Pulmonary vein** is the only vein that carries oxygenated blood (blood rich in $O_2$). It is called vein as it carries blood into heart.

## INTEXT QUESTIONS 15.1

1. Give one example each of animals with open and closed circulatory system.
   (i) Open circulation .....
   (ii) Closed circulation .....
2. Where in the heart are the following valves located?
   (i) Bicuspid .....
   (ii) Tricuspid .....
3. Name the following
   (i) Structure where the wave of contraction originates in heart to begin heart beat
   .....
   (ii) Structure connecting arteries with the veins
   .....
   (iii) Blood vessel that brings oxygenated blood from the lungs to the heart
   .....
   (iv) The blood vessel which collects and brings deoxygenated blood from brain and shoulder region to the heart .....

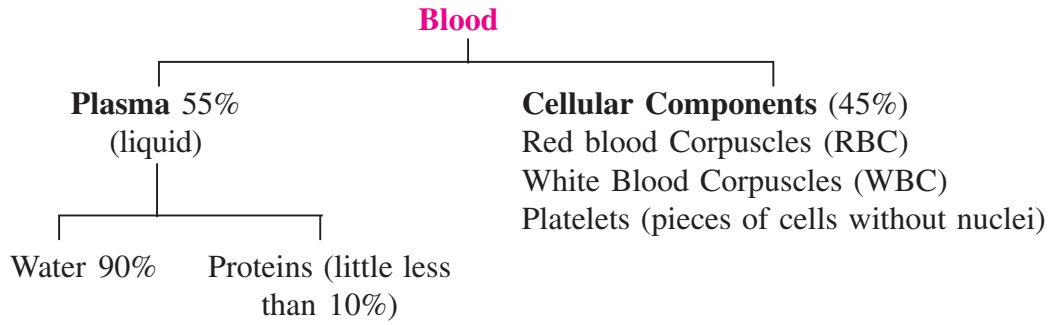
### (ii) Components and functions of blood

Blood is a red coloured, thick and slightly alkaline, fluid which keeps circulating in our body through the blood vessels. Why is blood so important? It is important because

1. it transports substances in the body such as Oxygen, nutrients, and hormones. It also carries waste to the kidney.
2. it protects body against disease.
3. it maintains normal body temperature.

### The components of blood

Blood is a fluid connective tissue made of plasma and blood cells.




### A. Plasma

It is a pale yellow liquid consisting of **blood proteins** like **albumin, globulin and fibrinogen.**

**Functions :** Plasma has the following functions :-

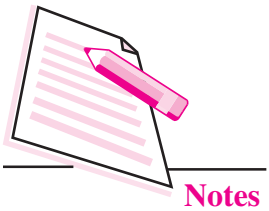
1. Transport of products of digestion from small intestine to various tissues.
2. Transport of waste products from tissues to excretory organs.
3. Transport of hormones from endocrine glands to target organs.
4. Maintenance of temperature by distribution of heat all over the body.
5. Provides factors for clotting of blood (Fibrinogen).
6. Retention of fluids in blood (through plasma proteins).
7. Maintenance of acid-base equilibrium in the blood.
8. Provides body immunity through antibodies (Immunoglobulins) which are made by one kind of WBC and then released into the plasma.

## B. Blood Cells

The cells of blood are **Red Blood Corpuscles (RBC)** and **White Blood Corpuscles (WBC)** and cell fragments, the **Platelets**. Blood cells are formed in the bone marrow. Their formation is termed **haemopoiesis**. Table 15.2 gives the idea of the cellular components, their origin, function and structure.

**Table 15.2 Cellular components of blood**

| Component | Origin of cells/mm | Number | Function |
|---|---|---|---|
| **Erythrocytes** (Red Blood corpuscle) | Bone marrow | 5.000,000 | transport of • oxygen to tissues and a large amount of • carbon dioxide back to lungs |
| **Leucocytes** (White Blood Corpuscles) | Bone marrow | 4,000 8,000 | |
| (a) Granulocytes (72% of total white blood cell count) | | 4900 | • engulf bacteria |
| neutrophils (70%) | Bone marrow | 105 | • anti-histamine properties |
| eosinophils (1.5%) | | 35 | • Produce histamine and heparin |
| basophils (0.5%) | | | |
| (b) Agranulocytes (28%) | | | |
| monocytes (4%) | Bone marrow | 280 | • engulf bacteria (Phagocytosis) |
| lymphocytes (24%) | Bone marrow, lymphoid tissue, spleen | 1680 | production of antibodies to provide immunity |
| **Platelets** | Bone marrow | 250,000 | initiate blood-clotting |



Notes

Do you know about the following blood disorders ?

1. Increase in R.B.C (More than normal) POLYCYTHEMIA
2. Decrease in R.B.C (less than normal) ANAEMIA
3. Increase in W.B.C.(more than normal) LEUKAEMIA
4. Decrease in W.B.C (less than normal) LEUKOPENIA

**Coagulation of Blood (Blood Clotting).** You must have, sometime or the other, got a cut on your finger and seen blood flowing out of it . You would have noticed that after a few minutes, the blood flow stops, as the blood thickens and forms a lump. This lump is called **clot**. The process of thickening of blood is called **coagulation or clotting of blood**. We are lucky that the blood clots and the bleeding stops. If it did not, a person with a very small wound would lose a lot of blood and die. When blood vessels are injured, a sequence of reactions takes place to prevent loss of blood. Steps involved are as follows :

Thromboplastin (from blood platelets) + Prothrombin (Plasma protein)

$Ca^{++}$ ions

Thrombin

Fibrinogen (Plasma protein) → Fibrin (Insoluble fibres)

FIBRIN + R.B.C → CLOT (Scab) Prevents blood loss

**Haemophilia** – A genetic disease that results in a condition where blood fails to clot

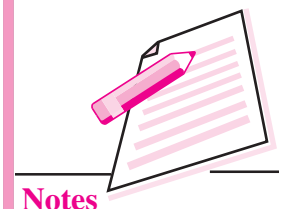
## Blood group

The blood of an individual may belong to any one of the four blood groups, A, B, AB, and O. Blood group remains constant throughout lifetime as it is genetically controlled and is inherited from parents. These blood groups are due to the presence of special proteins present on the membrane of RBCs termed as antigens. Antigens present could be A, B both A and B or no **Antigen** may be present in the cell membranes of RBC of a particular blood group. Blood plasma, on the other hand, contains **antibodies** a, b, or both a and b, or neither of the two. Antigen A reacts with antibody b and antigen B with antibody a causing clumping of blood.

| Blood Group | Antigen | Antibody |
|---|---|---|
| A | A | b |
| B | B | a |
| AB | A, B | – |
| O | – | a, b |

## Blood transfusion

When excessive blood is lost from the body either due to an accident, hemorrhage or during surgery (operation), doctors transfer blood from a healthy person (Donor) to the patient (Recipient). This is called **Blood Transfusion.** When blood transfusion





is needed, the red blood cells selected must belong to a group which will not be affected by any antibody in the patient's plasma.

**Clumping** of donor's blood (Agglutination) may take place upon transfusion if the blood group of donor does not match with that of the recipient. Table 15.3 shows blood groups and possibility of their transfusion.

> **Clumping** is a condition where the antibodies present in the plasma of recipient link donor's blood cells with each other to form a clump
>
> **Agglutination** is the process by which red blood cells clump together when the antigens on their surface react with complementary antibodies.

**Table 15.3 Matching of Blood Group, Safe and Unsafe After Transfusion of Blood.**

| Those who can safely receive blood of donor type | Donor | Blood group types who cannot |
|---|---|---|
| O, A, B, AB | O | |
| A, AB | A | O, B |
| B, AB | B | O, A |
| AB | AB | O, A, B, |

**The above table indicates that :**

| Blood group of recipient | Donor's blood group | | | | |
|---|---|---|---|---|---|
| | Group O | Group A | Group B | Group AB | √ Safe transfusion |
| Group O | √ | × | × | × | |
| Group A | √ | √ | × | × | × |
| Group B | √ | × | √ | × | |
| Group AB | √ | √ | √ | √ | Dangerous transfusion |

**The above table indicates that :**

1. Blood group of O type can be given to all groups. It is thus the **Universal Donor**. This is because there are no antigens in the blood of Group O.
2. Blood groups AB can receive blood from all other groups and is thus called **Universal Recipient**. No Antibodies present in the blood of Group AB, so no reaction with antigens of other blood groups.

## Rh Factor

Presence or absence of another blood protein in addition of ABO antigens makes a person $Rh^+$ or $Rh^-$.

> Rh factor in expectant mothers can sometimes cause problems. The blood of an $Rh^+$ embryo whose mother is $Rh^-$ is in danger of severe clumping.

Antibodies are produced in the mother against the $Rh^+$ blood cells of the embryo and whenever there is even the slightest mixing of foetal blood mothers blood.

### 15.3.5 Blood Pressure

You have already learnt that during systole, the ventricles contract and force the blood into the arteries, which carry it to all parts of the body. The flow of the blood in the arteries exerts a pressure on their elastic walls. This pressure is called **blood pressure**.

The pressure of blood at the time of ventricular contraction is higher and is called **systolic pressure**. When ventricles are relaxed and are being filled by blood, there is a drop in pressure. This lower pressure is called **diastolic pressure**. These two pressures can be measured in the arteries of the arms. The device used for measuring blood pressure is called **Sphygmomanometer**.

A reading of 120/75 means that the person's systolic pressure is 120 mm of mercury and diastolic pressure is 75 mm of mercury. A typical reading for a healthy adult is 120 ± 570 ± 5 mm of mercury.

The difference between diastolic and systolic pressure can be felt as a throb in the arteries of the wrist. This throb at the wrist is called **Pulse**. The number of throbs felt at a particular point on the wrist (due to systole) per minute is called **Pulse Rate**. It is equal to the number of heart beats i.e. around 70 beats per minute for a normal adult.

## INTEXT QUESTIONS 15.2

1. Name the following
   (i) The term given to the production of blood cells …….....…….
   (ii) The three proteins present in the plasma
   (i) ……. (ii) ……. (iii) …….
   (iii) Cell fragments of blood involved in the clotting of the blood
   …….....…….
2. Fill in the blanks
   (i) Transfer of blood from donor to recipient is called ….....……
   (ii) Antigens are present on ……, and antibodies in the ……..
   (iii) People from blood group O can receive blood from blood group /groups ……
   (iv) Blood pressure is measured by an instrument called……. The reading for a person with normal blood pressure will be around ….....…….....

## 4. Lymphatic system

Our body has the presence of two kinds of circulating fluids – blood and lymph. Of these you have seen and felt the first (i.e. blood) in your own body, but lymph remains unnoticed even if it oozes out at any point of injury because it is colourless.

This system consists of a series of branching vessels and a collection of lymphatic organs. Let us understand. A continuous exchange of materials between the blood capillary and the intercellular fluid (fluid present between cells of tissues) goes on. Some important components like proteins that could not be sent back to blood capillaries from intercellular fluid, are taken up by the lymph capillaries as lymph and drained into veins in the lower neck portion of the body (subclavian vein). Lymph should be regarded as **modified tissue fluid**.

The clear, colourless liquid moving out of the capillary wall is called Lymph. Lymph comes into direct contact with body cells. (Fig. 15.5)

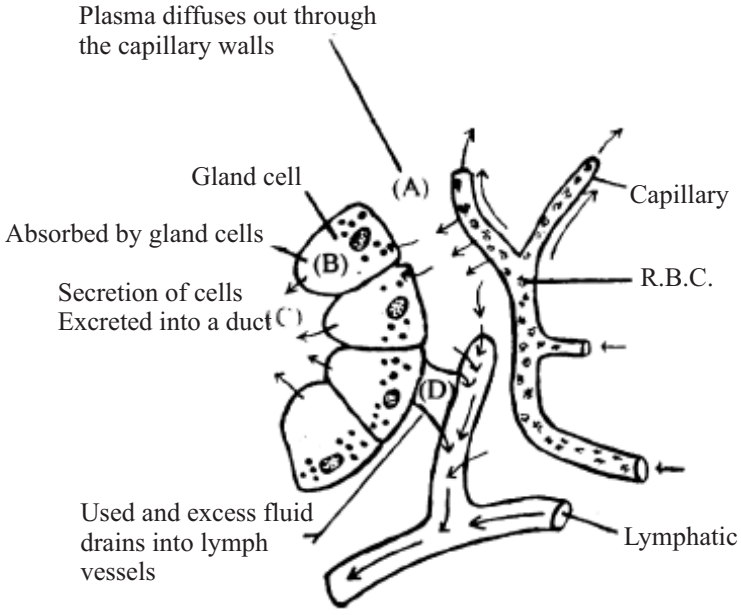



**Fig. 15.5** Flow of lymph between capillaries and lymph vessel

### (a) Functions of lymph

(i) Supplies nutrition and oxygen to those parts of body where blood cannot reach

(ii) Drains away, excess tissue fluid from extra-cellular spaces and pours back into the blood.

(iii) Absorbs and transports fats absorbed from small intestine (lacteals)

(iv) Collects nitrogenous waste

(v) Lymphocytes and antibodies present in lymph help in removing bacteria

### (b) Differences between blood and lymph

Blood differs from lymph in a number of ways as shown in table 15.4

**Table 15.4** Differences between Blood and Lymph

| Blood | Lymph |
|---|---|
| 1. Red in colour due to presence of haemoglobin | 1. Colourless fluid |
| 2. Flows rapidly | 2. Flow is very slow |
| 3. Contains RBC, WBC, Platelets and Plasma | 3. Contains plasma and WBC |
| 4. Route of blood flow<br>Heart<br>↓<br>Arteries<br>↓<br>Capillaries<br>↓<br>Veins<br>↓<br>Heart | 4. Route of lymph flow<br>Tissue Spaces<br>↓<br>Lymph Capillaries<br>↓<br>Lymph Vessels<br>↓<br>Subclavian Vein<br>↓<br>Heart |

The clear, colourless fluid that collects in a blister to provide protection to the underlying tissue is **lymph**.

The lymphatic system consists of a large number of **lymph ducts, lymph nodes and lymph vessels** (Fig. 15.6). It lacks a pumping mechanism. Fluid is pushed by muscle movement.

The lymph nodes are scattered throughout the body. They are more concentrated in the neck, armpits and groins

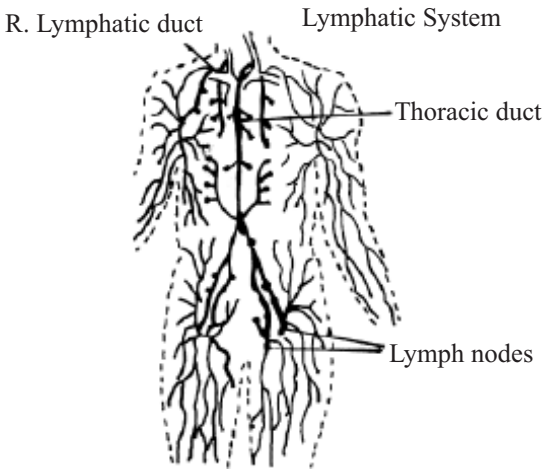



**Fig. 15.6** Lymph vessels and lymph glands

## Lymph nodes

Each node is a clump of tissue housing a number of lymphocytes. These nodes act as filters for bacteria, viral particles and cancerous cells. These resident lymphocytes then immediately attack the disease causing germs or pathogens.

The spleen and tonsils are lymphoid organs.

### Spleen

It is the largest lymphoid organ and has the following functions

(i) Haemopoiesis – Formation of Blood cells in the foetus

(ii) Destruction of old and worn out blood cells and hence termed as 'grave yard' of RBC.

(iii) Blood reservoir

(iv) Defensive action by engulfing bacteria

## 15.5 IMMUNITY

The body's ability to resist or protect itself from the harmful effects of disease producing substance or organisms is called Immunity.

Any substance that causes production of antibodies in response of the body metabolism, is known as **antigen**. Antigen may be bacteria, viruses, or allergens (such as pollen grains) which cause allergy.

Antigens enable the body to protect itself with the help of antibodies produced by lymphocytes (WBC)

Immunity could be **natural or acquired**. Natural immunity is by birth. Acquired immunity develops during lifetime. It develops due to exposure to a disease or by vaccination.

Acquired immunity is of two types

**(a) Active Immunity :** Develops during exposure to disease causing germs. The body produces antibodies that remain in the blood to prevent further infection by that particular pathogen or disease causing organism. Vaccine containing weakened germs is administered to provide active immunity e.g DPT vaccine is given for developing immunity against diphtheria, pertusis (whooping cough) and tetanus and BCG vaccine is given for immunity against tuberculosis

People also develop immunity against chicken pox, small pox and measles after suffering from these diseases. This form of immunity is usually a life long immunity.

**(b) Passive Immunity :** This form of immunity is shortlived. It is developed by injecting readymade antibodies (collected from other animals). **Anti tetanus serum (ATS vaccine)** provides temporary immunity against tetanus.

A vaccine is a sample of an antigen, too small to cause a disease, but enough to produce antibodies. Vaccines have been developed for a number of diseases like polio, mumps, measles, tetanus, diphtheria, and cholera.

### Cells Of Immune System

Lymphocytes are cells of the immune system. There are two major types of lymphocytes, T-cells and B-cells, both develop in the **Bone Marrow.**

| T-Cells | B-Cells |
|---|---|
| 1. Mature in thymus glands | Mature in lymphoid tissues like tonsils and appendix |
| 2. T-cells identify antigens and destroy them | Recognise antigen with the help of surface receptors |
| 3. Attack directly | Produce a large number of antibodies for attack |
| 4. Life span is upto 3-4 years | Anitbodies are short lived |

A person may lack T-cells or B-cells, or both. Such persons are highly prone to infections

**Immuno Deficiency Disorders**

Hereditary, congenital (by birth) or acquired defects in immune response are called **Immuno Deficiency Disorders.**

**SCID** and **AIDS** are two common examples of such disorders.

SCID (Severe Combined Immuno-Deficiency Syndrome) is caused due to the absence of both T-cells and B-cells. This defect is present from birth.

AIDS (Acquired Immuno Deficiency Syndrome) causes considerable reduction in T-cells and ultimate destruction of the Immune System. It is caused by HIV (Human Immuno Virus).

**You should know**

AIDS may be caused by

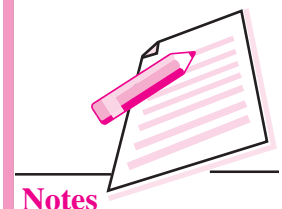
1. Sexual contact with a person infected with HIV
2. Blood transfusion from HIV infected person
3. Sharing of contaminated needles with HIV sufferers or Drug addicts
4. From infected mother to foetus through the placenta

## 15.6 DISORDERS RELATED TO BLOOD AND HEART

You must have heard of people suffering from high blood pressure. In these people, the blood pressure is more than the normal (120/75). The state of having high blood pressure is called **hypertension**. Hypertension is usually related to stress, overweight, age or faulty diet.

Other heart related disorders are **atherosclerosis** and **arteriosclerosis.** Sometimes, especially if too much of fatty food is taken over a long period, there is a tendency for fat to deposit on the inner wall of the arteries. Such a deposit is called **atheroma** and the disorder **atherosclerosis**. This narrows the lumen of the arteries supplying the heart and consequently interfere in the functioning of the heart.

Also with age the wall of the arteries harden and lose their flexibility. Further, there may be deposits on the inner side of the walls of the arteries supplying the heart.





This condition is **arteriosclerosis** and interferes with normal functioning of the heart. To remedy the situation, the lumen of the arteries of the heart have to be widened by placing a small piece of tube (stent). This is called **ballooning angioplasty**. Sometimes the artery may have to be replaced and this treatment is called 'heart by-pass'.

### ECG

Electrocardiograph is a machine which can record the heartbeat like a graph which is called **eletrocardiogram (ECG)**. From the ECG, the doctor can make out which chamber of the heart is not contracting or relaxing properly and suggests treatment accordingly.

## INTEXT QUESTIONS 15.3

1. Fill in the blanks :
   (i) The clear colourless liquid flowing out of the blood capillary walls is called …..……
   (ii) Lymphatic system consists of …..…… lymph nodes and …..……
   (iii) A number of …..…… are present in lymph nodes and attack bacteria
2. Give one example of lymphoid organ in your body …..…….....……
3. Give **two** examples of Immuno Deficiency Syndrome ….....……
4. Name the **two** kinds of lymphocytes of your immune system …...…….
5. Name **two** heart related disorders
   (i) ..... (ii).....

## WHAT YOU HAVE LEARNT

- Circulatory system is of two kinds; closed and open type.
- Circulatory system consists of muscular pump (heart), tube like vessels (blood vessels) and circulating fluids (blood, lymph).
- Blood helps in transport of gases, collection of wastes, maintenance of body temperature and protection from diseases.
- Wave of contraction in the heart is conducted from S.A. node to A.V. node to bundle of HIS, to Purkinje fibers.

- Blood vessels are arteries, capillaries and veins
- Superior and inferior venae cavae bring deoxygenated blood to the heart. Pulmonary vein brings pure (oxygenated) blood to the aorta and aorta supplies it to the body.
- Production of blood is called haemopoiesis which takes place in the bone marrow
- Blood consists of plasma and cell components viz., RBC, WBC and Platelets
- In the A, B, O Blood group system, a person with blood group O is a universal donor and person with blood group AB is universal recipient.
- Rh factor is important in matching blood groups for transfusion as well as in the case of expectant mothers.
- Normal blood pressure for healthy person is 120 ± 5/75 ±5 mm of mercury and is measured by Sphygmomanometer.
- The colourless fluid moving out of capillary wall is called lymph
- Spleen and tonsils are examples of lymphoid organs and house lymphocytes (T-cells and B-cells)
- Body's ability to protect itself from harmful substances is called immunity
- Disorder of the immune system diminishes resistance to diseases. SCID is an immunodeficiency disorder from birth; AIDS is another one caused by HIV virus.

## TERMINAL EXERCISES

1. Give one function of each of the following :
   (i) R.B.C.
   (ii) Platelets
   (iii) Plasma
2. With the help of a flow chart describe the steps involved in the coagulation of blood
3. Why is a person with blood group AB called universal recipient?
4. Differentiate between the systolic and diastolic pressures. What are the values of these pressures for a normal human adult?
5. Give **three** differences between lymph and blood.
6. What is immunity? Differentiate between active and passive immunity.
7. What are (i) hypertension and (ii) atherosclerosis?
8. What is an ECG and what is its function?

## ANSWERS TO INTEXT QUESTIONS

**15.1**

1. Name the following
   - (i) Prawn, insects etc
   - (ii) Vertebrates like human, fish, birds
2. (i) Between left atrium and left ventricle
   - (ii) Between right atrium and right ventricle
3. (i) Sino-atrial node (ii) capillaries (iii) pulmonary vein
4. Superior vena cava

**15.2**

1. (i) Haemopoiesis
   - (ii) Ablumin, globulin and fibrinogen
   - (iii) Platelets
2. (i) Blood transfusion
   - (ii) Cell membrane of RBC; plasma
   - (iii) Only from blood group O
   - (iv) Sphygmomanometer, 120 ≠ 5 / 75 ± 5 mercury

**15.3**

1. (i) Lymph
   - (ii) Lymph ducts and lymph vessels
   - (iii) Lymphocytes
2. Spleen or tonsils
3. SCID and AIDS
4. T-cells, B-cells
5. Hypertension, atherosclerosis, arteriosclerosis (any 2)